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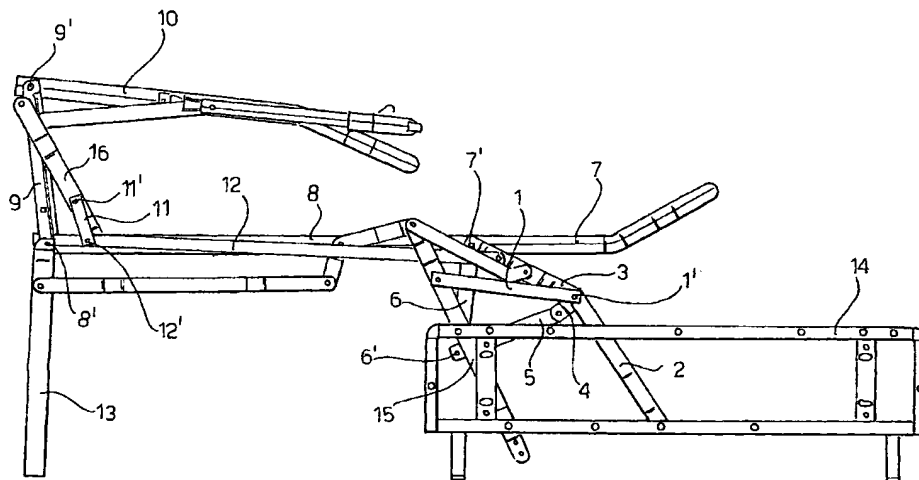
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[Continued on next page]

(54) Title: **OPENING/CLOSING MECHANISM FOR A SOFA BED**



(57) Abstract: An opening/closing mechanism for a sofa bed is described which comprises a plurality of frames - hinged to each other and able to contain, both in the "bed" configuration and in the "sofa" configuration, a rectangular shaped mattress - and a lever system, hinged by means of at least two arms to a support structure, which moves the frames to allow the passage from the "bed" configuration to the "sofa" configuration and vice versa. Integral with one of the arms is a lever which, while the sofa bed passes from the "bed" configuration to the "sofa" configuration, acts on a lever assembly moving the frame nearest to the support structure to prevent said frame from forming an angle of less than 90° with the adjacent frame and at the same time making it rotate upwards by about 90°.

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- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designation US
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OPENING/CLOSING MECHANISM FOR A SOFA BED.**DESCRIPTION**

5 Long known and widely available on the market are opening/closing mechanisms for sofa beds comprising a plurality of frames - hinged to each other and able to contain, both in the "bed" configuration and in the "sofa" configuration, a mattress – and a lever system - hinged by means of two arms to a supporting structure able to contain, in the "sofa" configuration, the frames, the lever system and the mattress – which
10 moves the frames to allow the passage from the "bed" configuration to the "sofa" configuration and vice versa.

The lever system comprises a plurality of lever assemblies, interconnected with each other, which act on the frames to fold them tidily into the supporting structure ("sofa" configuration), respectively to align them with each other ("bed" configuration).
15

The opening/closing mechanisms of the prior art have numerous drawbacks and/or limitations which make – or can make – opening/closing of the sofa bed more tiresome and difficult and/or which affect – or can affect - the reliability of said
20 mechanism.

For example, by using known opening/closing mechanisms, when the sofa bed passes from the "bed" configuration to the "sofa" configuration the frame nearest to the supporting structure comes – or can come – excessively close to the adjacent frame, limiting the space available for the folded mattress: to bring the sofa bed into the
25 "sofa" configuration it is – or it can be – necessary to "force" it, exerting thereupon a pressure which is harmful for the integrity of the mattress and/or for the opening/closing mechanism.

30 The opening/closing mechanism disclosed in claim 1, comprising means able at least to prevent the frame nearest the supporting structure from coming too close to the adjacent frame whilst the sofa bed is passing from the "bed" configuration to the "sofa" configuration, allows the above described drawbacks and/or limitations presented by the known opening/closing mechanisms to be overcome and is

particularly suitable to allow the sofa bed to pass easily from the "sofa" position to the "bed" position and vice versa.

Further characteristics of the invention form the subject matter of the dependent
5 claims.

An exemplary embodiment of the invention will be described herein, purely by way of non-limiting illustration, with reference to the appended figures, in which:

Figure 1 shows diagrammatically a mechanism according to the invention partially
10 closed;

Figure 2 shows diagrammatically an exploded view of the means able to couple to each other the levers 2, 3 and 4 of Figure 1;

Figures 3-14 show diagrammatically successive positions of a mechanism according to the invention whilst it passes from the "bed" configuration to the "sofa"
15 configuration;

Figures 15 e 16 show diagrammatically a mechanism according to the invention comprising further means applied to said mechanism to allow it to take on further intermediate configurations between the "bed" configuration and the "sofa" configuration.

20 Figure 1 shows diagrammatically a mechanism according to the invention, partially closed, which comprises a plurality of frames (7-10) hinged to each other at points 7', 8' and 9' – able to contain (both in the "bed" configuration and in the "sofa" configuration) a rectangular shaped mattress (omitted in the appended figures for the sake of simplicity of the graphic representation) – and a lever system which, by acting
25 on the frames (7-10), allows the sofa bed to pass from the "bed" configuration to the "sofa" configuration and vice versa.

The lever system is composed of a plurality of lever assemblies, interconnected with each other, each of which performs a different function, such as, for example, raising
30 the entire mechanism, closing/opening the frame 7, moving the central foot 13 and so on.

The raising lever system is hinged to the frame 14 by means of a pair of arms (2, 15); integral with the arm 2 is a lever 4 which, by acting on the lever assembly (1, 3, 5, 6)

which moves the frame 7, prevents the angle between the frame 7 and the adjacent frame 8 from becoming less than 90° whilst the sofa bed passes from the "bed" configuration to the "sofa" configuration – thus preventing the frame 7 from coming too close to the frame 8 – and makes the frame 7 rotate upwards by about 90° (Figures 10-14).

Whilst the sofa bed passes into the "sofa" configuration, the arms (2, 15) rotate (clockwise in the exemplary embodiment shown in the appended figures) pulling the lever system and the frames (7-10).

In particular, the arm 2 moves the levers 1, 3 and 6 (the latter by means of the levers 4 and 5); on the lever 6 there is an abutment element which, when the lever 6 is aligned with the frame 7, pulls with it the frame 7 until the mechanism has reached the "sofa" configuration.

In the exemplary embodiment described herein, one end of the lever 4 is made integral with one end of the arm 2 by means of coupling means described (by way of non limiting example) in Figure 2 but, without departing from the scope of the invention, it is possible to replace the lever 4 with an appendix of the arm 2.

The movement system of the frame 7 described herein has numerous advantages, amongst which:

- it makes it possible to have a greater momentum (which makes it easier to reach the "sofa" configuration) to make the frame 7 rotate and to fold the mattress: this momentum is proportional to the length of the lever 6, that is to the distance between points 6' and 7';
- the lever 6 hooks the frame 7 when the latter reaches the lowest point of its course (Figure 9): this allows the "bed" configuration to be left even if the frame 7 is not aligned with the frame 8, that is, if the two frames form an angle smaller than 180° ;
- it makes it possible always to have an angle of not less than 90° between the frames 7 and 8.

The opening/closing mechanism of the present invention advantageously further comprises an anti-tipping system formed by means of the levers 11 and 12, hinged to

each other at a first end, which – when the opening/closing mechanism is in the “bed” configuration – are aligned with each other (Figure 3) and do not allow accidental closing of the sofa bed if the user sits on the frame 7.

- 5 As shown in Figure 1, the second end of the lever 11 is hinged at the point 11' to the lever 16 whilst the second end of the lever 12 is hinged to the lever 3.

This anti-tipping system is functionally equivalent to that – consisting of a lever having a length equal to the total length of levers 11 and 12 and having a long slotted
10 hole – provided in mechanisms of the prior art but, being made with two levers hinged to each other, it makes it possible to have a less deep and therefore more comfortable seat on the sofa.

Figure 2 shows diagrammatically an exploded view of means suitable to couple
15 together the arm 2 and the lever 4 without locking the lever 3 – belonging to the lever assembly that moves the frame 7 – which, to avoid problems of interferences, must be placed between the arm 2 and the lever 4 and which must be free to rotate at least with respect to the lever 2.

- 20 As can be seen from Figure 2, the ends of the arm 2 and of the lever 4 have a shaped hole in which a first bush 1''' is inserted, whose outer profile has a shape matching that of the inner profile of the holes present at the ends of the arm 2 and the lever 4.

On the first bush 1''' there is mounted a second bush 1'', placed between the ends of
25 the arm 2 and the lever 4, which has an inner profile with a shape matching that of the outer profile of the first bush 1''' and an outer circular profile having a diameter little smaller than that of a circular hole present at one end of the lever 3, which rotates freely around the second bush 1''.

- 30 In particular, the outer profile of the second bush 1'' is of such a diameter as to be able to be inserted without effort and (practically) without slack into the circular hole present at the end of the lever 3.

Figures 3-14 show diagrammatically successive positions of a mechanism according to the invention whilst it passes from the "bed" configuration (Figure 3) to the "sofa" configuration (Figure 14); Figure 1 corresponds to Figure 4.

- 5 For the sake of simplicity of the graphic representation, in Figures 3-14 only the arm 2, the frame 7 and the levers (3, 4, 5, 6) which move the frame 7 have been denoted by the corresponding reference numerals.

10 Figures 15 and 16 show diagrammatically a mechanism according to the invention comprising further means 20 applied thereto to allow it to assume one or more configurations – herein under called "relax" – between the "bed" configuration and the "sofa" configuration.

15 When it is desired for a mechanism according to the invention to be able also to take on the "relax" configurations, there are applied to said mechanism – at point 7' (Figure 1) where the frames 7 and 8 are hinged – further means 20, which comprise a snap system 21 (Figure 16) integral with a pair of elements (22, 23) able to be fixed by means of screws (or by other functionally equivalent fixing means) to the frame 7 and to the frame 8, respectively.

20 In Figure 15 the means 20 further comprise a closing element 26, removed in Figure 16 to show the snap system 21; furthermore in Figure 15 the elements 22 and 23 bear two staves 27 (that is, two of the elements forming the sleeping surface of the sofa bed), omitted in Figure 16 for the sake of simplicity of the graphic representation.

25 The snap system 21 – which will not be described in detail herein in that it is per se known, from example from application PCT No. WO 02/054915 in the name of the Applicant – comprises at least one cam 24 and a toothed profile 25 coupled to each other.

30 The toothed profile 25 has a plurality of hollows, each of which is associated with one of said "relax" configurations, intermediate between the "bed" configuration and the "sofa" configuration.

To make the mechanism according to the invention pass from the "bed" configuration to the chosen "relax" configuration it is sufficient to raise the frame 7 until the cam 24 of the snap system 21 passes into the hollow of the toothed profile 25 corresponding to the chosen "relax" position; to make the mechanism according to the invention
5 return to the "bed" position it is sufficient to raise the frame 8 to release the cam 24 of the snap system 21 from the toothed profile 25.

The further means 20 can be applied to a mechanism according to the invention, respectively removed from said mechanism, without modifying and/or interfering with
10 the operation of said mechanism.

If the mechanism according to the invention is brought from the "relax" configuration to the "sofa" configuration without first being returned to the "bed" configuration, the abutment element present on the lever 6 (Figure 2) draws with it the frame 7, raising it
15 and releasing the snap system 21: the presence of further means 20 does not, therefore, prevent the mechanism according to the invention from reaching the "sofa" configuration.

Without departing from the scope of the invention, a person skilled in the art can
20 apply to the already described opening/closing mechanism for a sofa bed all the modifications and improvements suggested by normal experience and/or by the natural evolution of the art.

CLAIMS

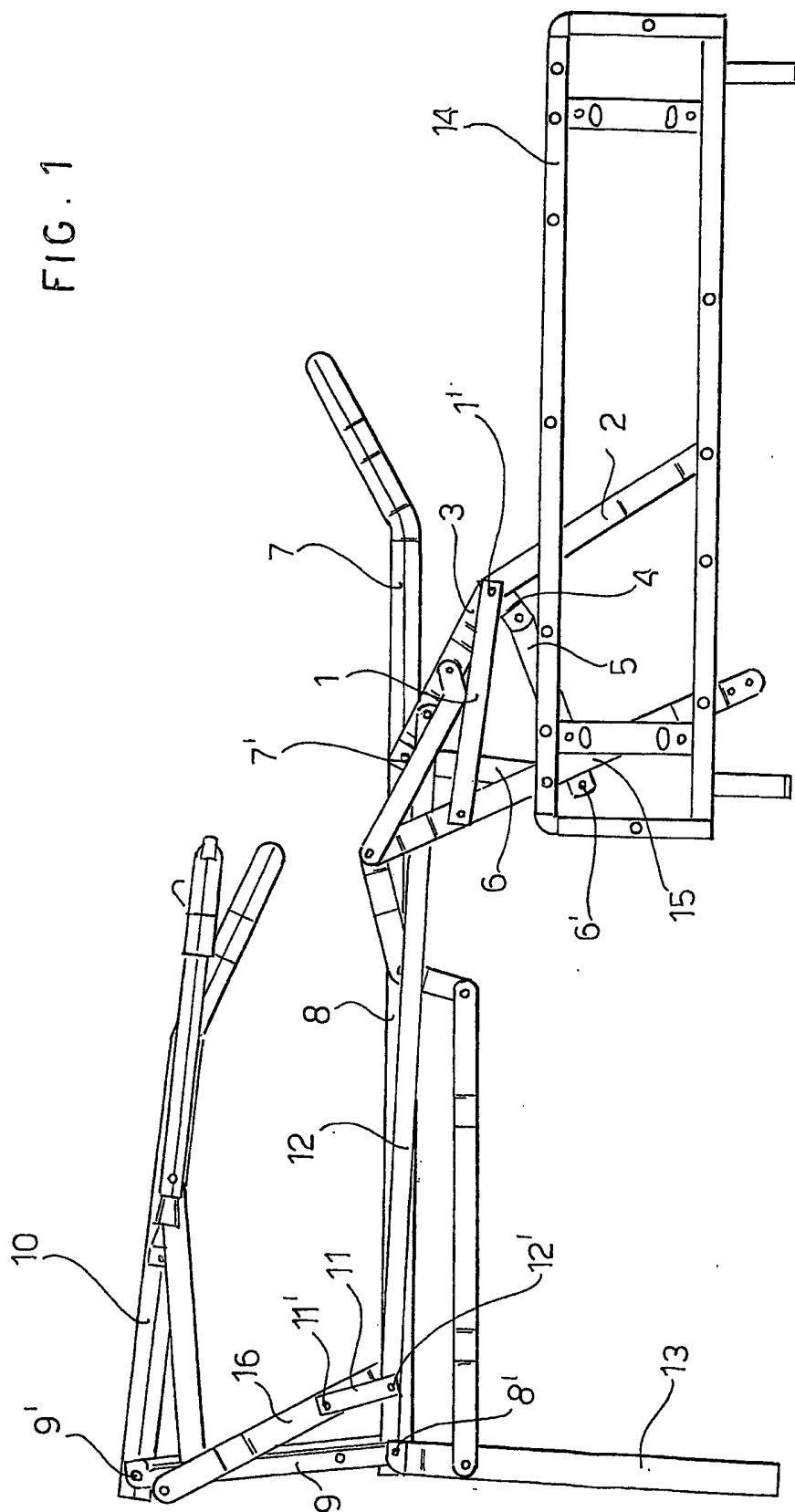
1. An opening/closing mechanism for a sofa bed comprising a plurality of frames (7-10) hinged to each other and able to contain a mattress and a lever system – hinged by means of at least two arms (2, 15) to a support structure (14) – which moves the frames (7-10) to allow the passage from the “bed” configuration to the “sofa” configuration and vice versa, characterised in that one of the arms (2) comprises means (4) able to operate the lever assembly (1, 3, 5, 6) which moves the frame (7) nearest to the support structure (14) to make said frame (7) rotate upwards whilst the sofa bed passes from the “bed” configuration to the “sofa” configuration and in that the angle formed by said frame (7) with the adjacent frame (8) is always not less than 90°.
2. A mechanism according to claim 1, characterised in that the lever assembly (1, 3, 5, 6) that moves the frame (7) causes the frame (7) to rotate upwards about 90°.
3. A mechanism according to claim 1, characterised in that said operating means (4) consist of an appendix of the arm (2).
4. A mechanism according to claim 1, characterised in that said operating means (4) consist of a lever having one end integral with one end of the arm (2).
5. A mechanism according to claim 4, characterised in that
 - the ends of the arm (2) and of the lever (4) have a shaped hole in which a first bush (1'') - having an outer profile with a shape matching that of the inner profile of the shaped holes present at the ends of the arm (2) and of the lever (4) - is inserted;
 - on the first bush (1'') there is mounted a second bush (1'') placed between the ends of the arm (2) and of the lever (4) and having an inner profile with a shape matching that of the outer profile of the first bush (1'') and a circular outside profile with a smaller diameter than that of the circular hole present at one end of a lever (3) belonging to the lever assembly (1, 3, 5, 6) that moves the frame (7) nearest to the support structure (14);
 - the lever (3), placed between the ends of the arm (2) and of the lever (4), is able to rotate with respect to the arm (2) around the second bush (1'').

6. A mechanism according to claim 1, characterised by further comprising an anti-tipping system comprising two levers (11, 12) hinged to each other at a first end and aligned with each other when the mechanism is in the "bed" configuration.
- 5 7. A mechanism according to claim 6, characterised in that the second end of one (11) of the levers (11, 12) belonging to the anti-tipping system is hinged to a lever (16) belonging to the lever system which moves the frames (7-10) whilst the second end of the other lever (12) of the anti-tipping system is hinged to a lever (3) belonging to the lever assembly (1, 3, 5, 6) which moves the frame (7).
- 10 8. A mechanism according to claim 1, characterised by further comprising means (20) able to allow the sofa bed to take on configurations intermediate between the "bed" configuration and the "sofa" configuration.
- 15 9. A mechanism according to claim 8, characterised in that the further means (20) are applied at the point (7') where the frame (7) nearest the support structure (14) and the adjacent frame (8) are hinged.
- 20 10. A mechanism according to claim 9, characterised in that the further means (20) comprise at least a snap system (21) integral with a pair of elements (22, 23) able to be fixed to the frame (7) nearest to the support structure (14), respectively to the adjacent frame (8).
- 25 11. A mechanism according to claim 10, characterised in that the snap system (21) comprises at least one cam (24) and a toothed profile (25) coupled to each other.
- 30 12. A mechanism according to claim 11, characterised in that the toothed profile (25) has a plurality of hollows, each of which is associated with one of said configurations intermediate between the "bed" configuration and the "sofa" configuration.
13. A mechanism according to claim 9, characterised in that the further means (20) further comprise a closing element (26) fixed to the body of the further means (20).

14. A mechanism according to claim 10, characterised in that each of the elements (22, 23) able to be fixed to the frame (7) nearest the supporting structure (14), respectively to the adjacent frame (8), carries one of the elements forming the sleeping surface of the sofa bed.

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FIG. 1



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FIG. 2

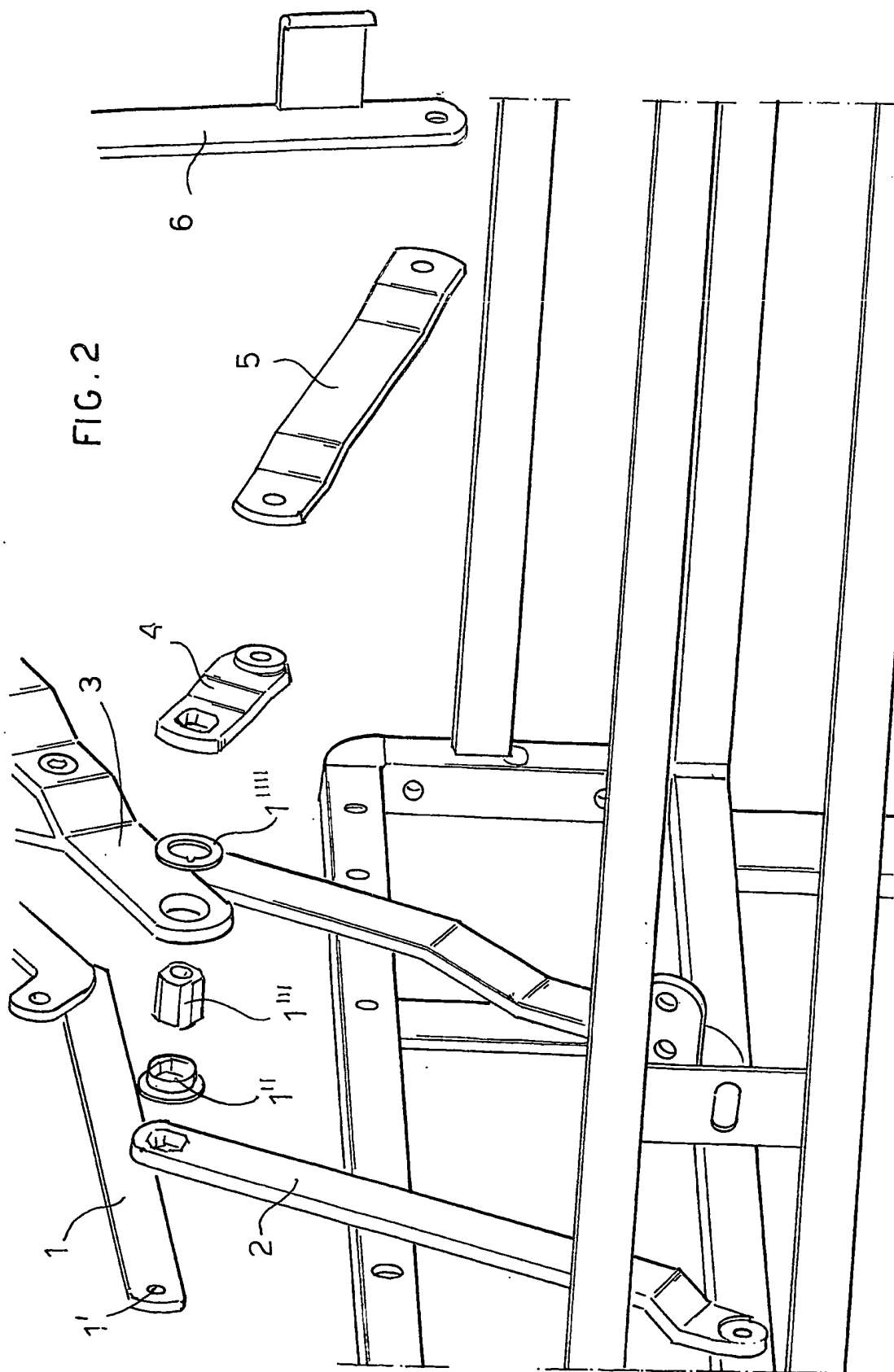
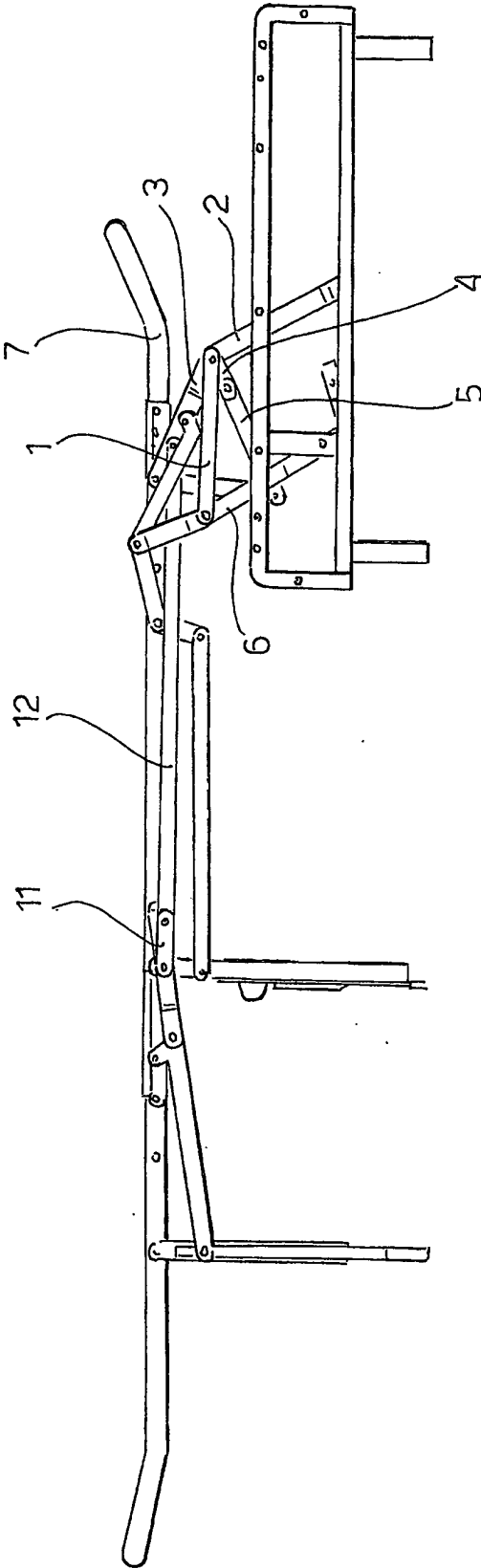


FIG. 3



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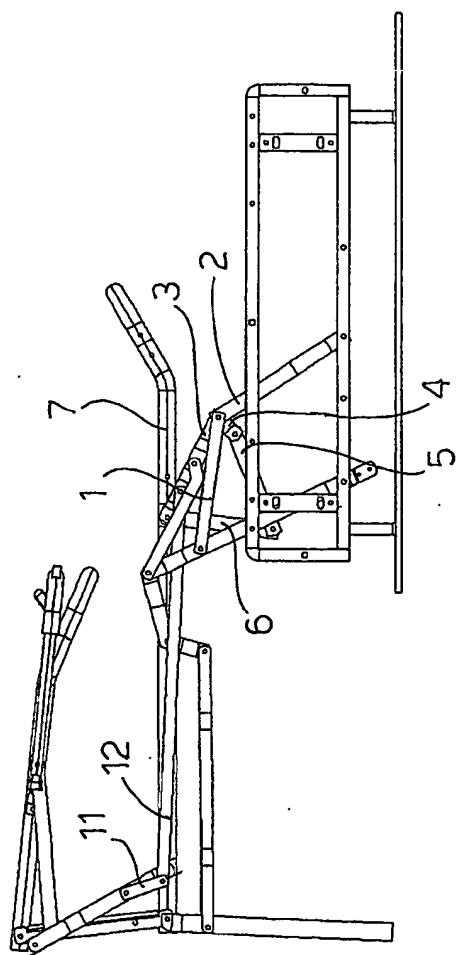


FIG. 4

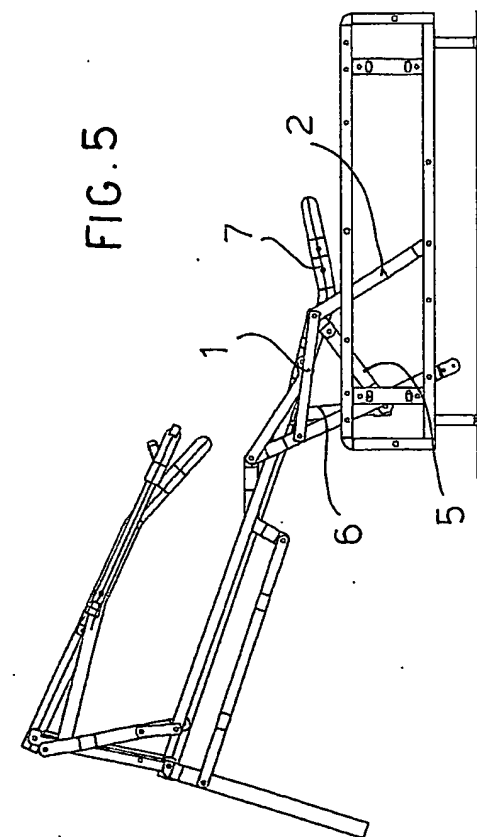


FIG. 5

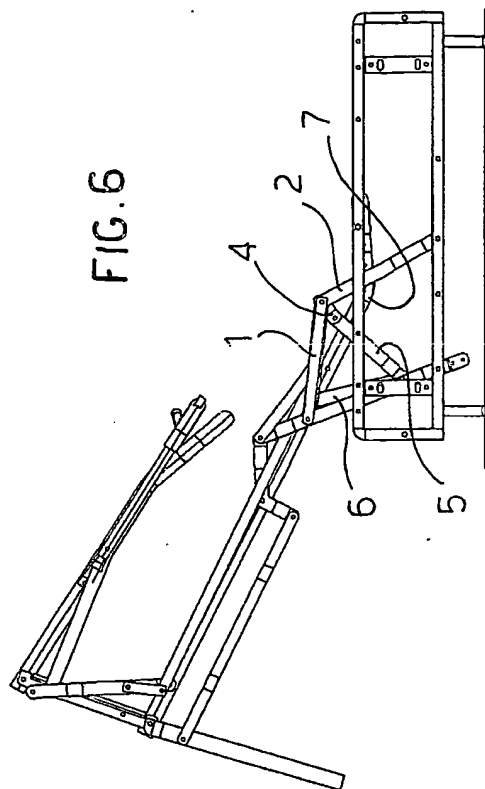
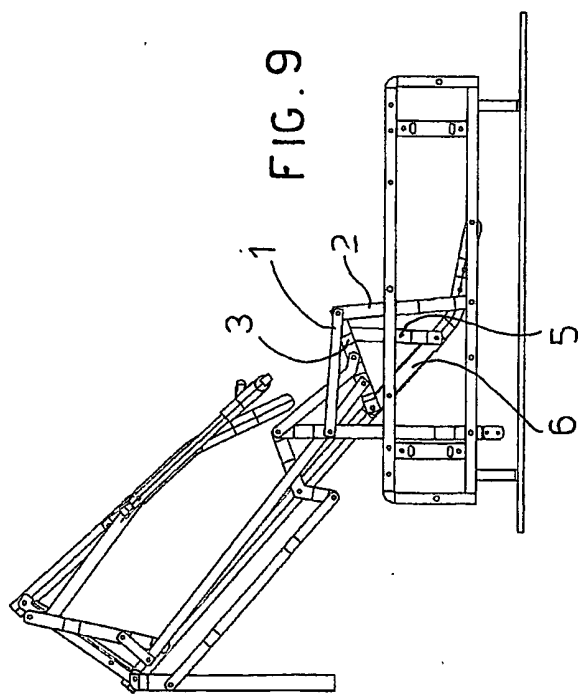
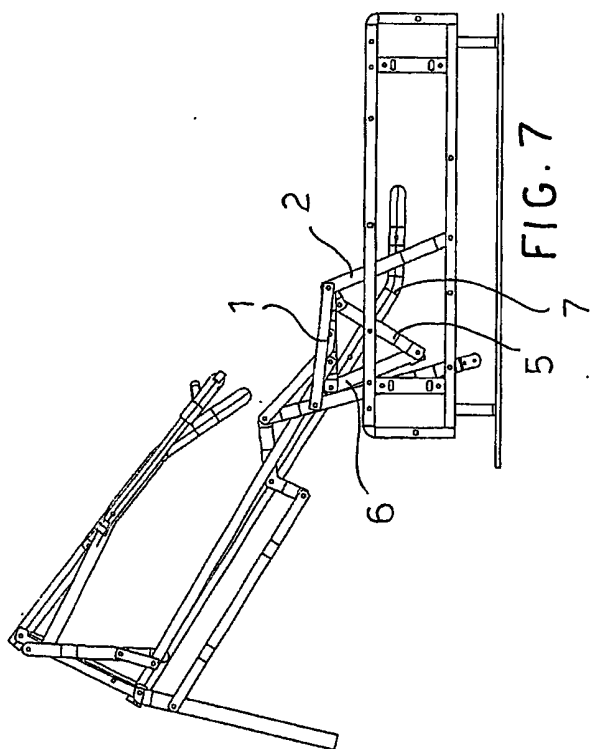
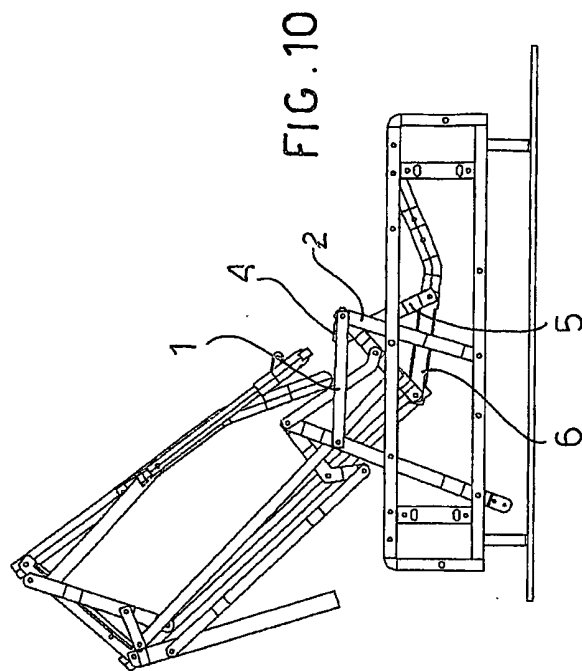
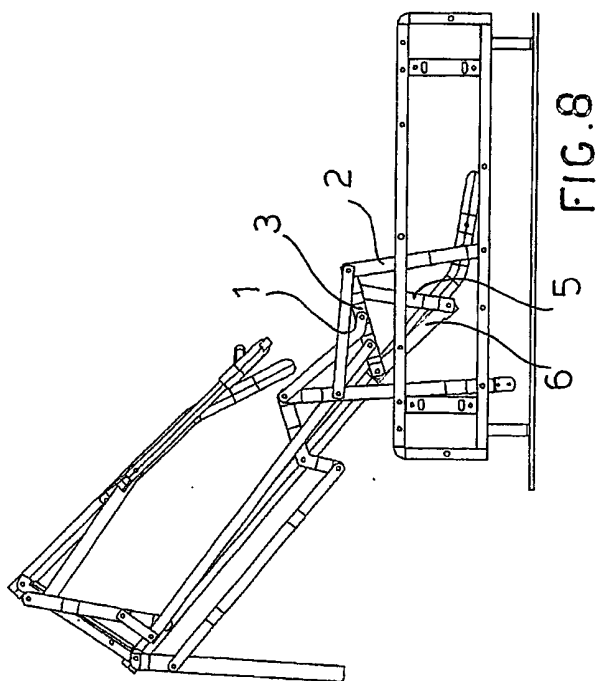
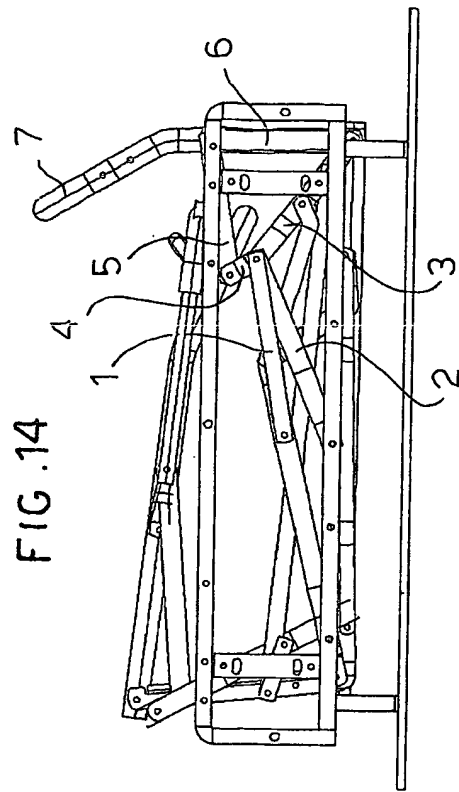
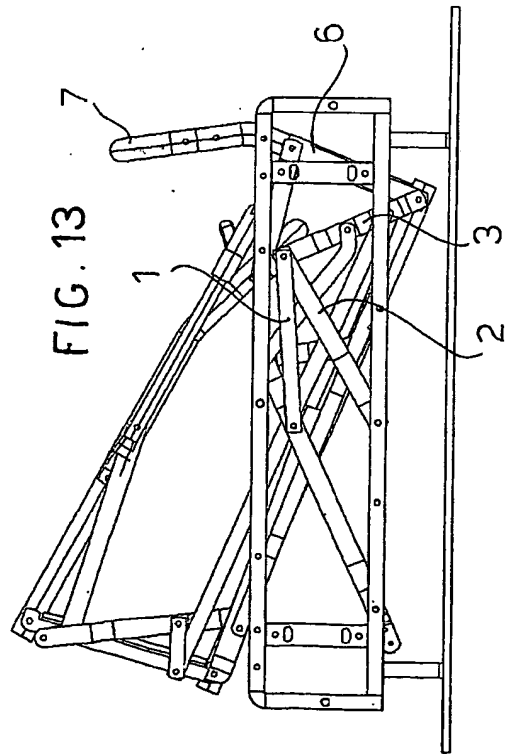
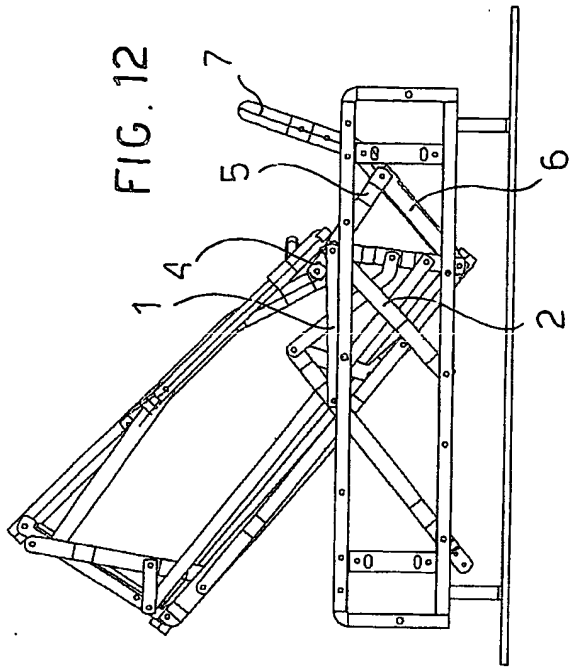
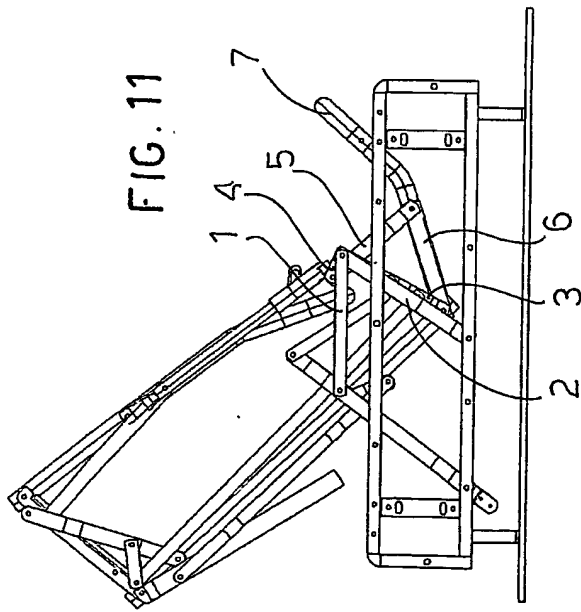


FIG. 6



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7 / 8

FIG. 15

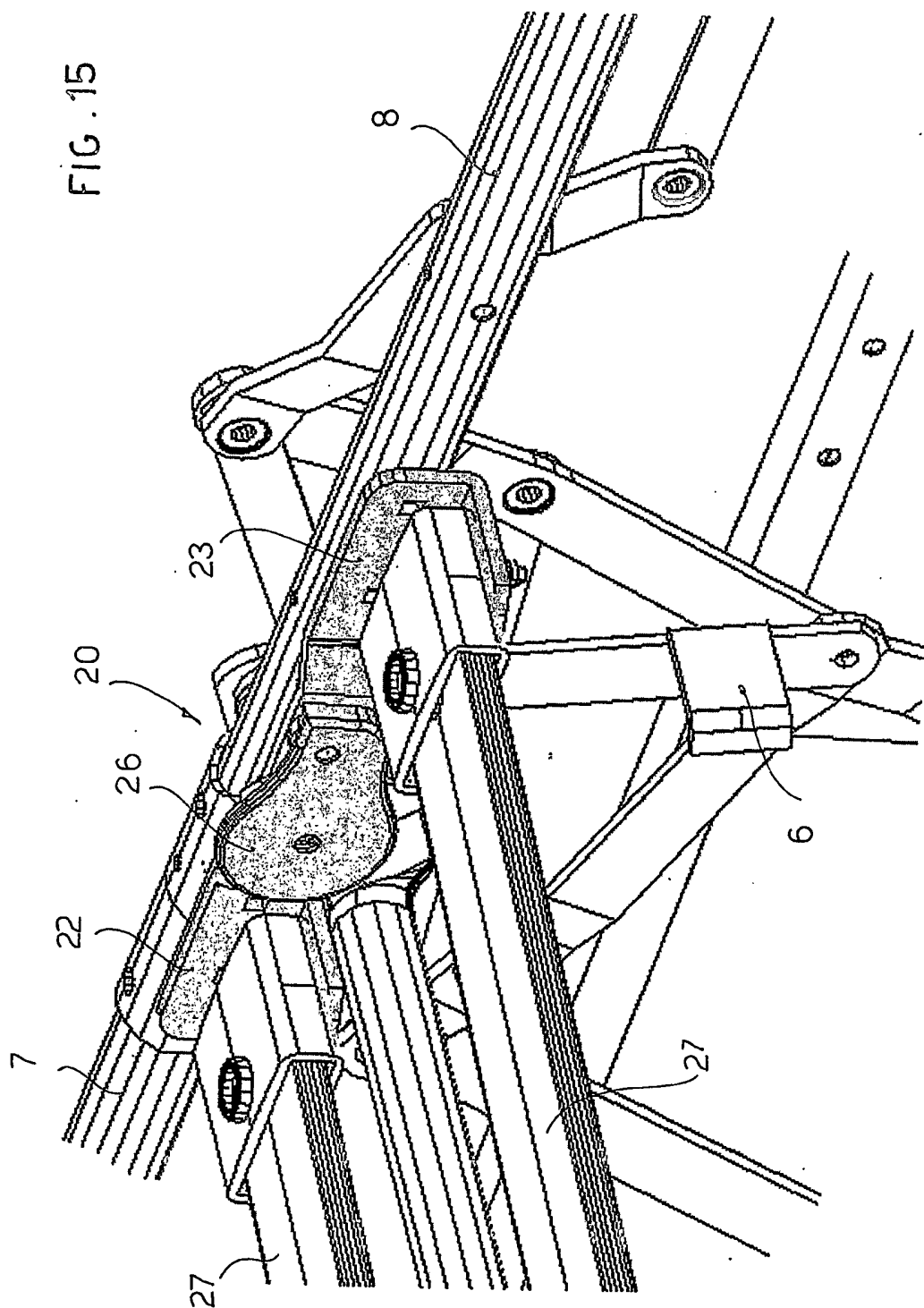
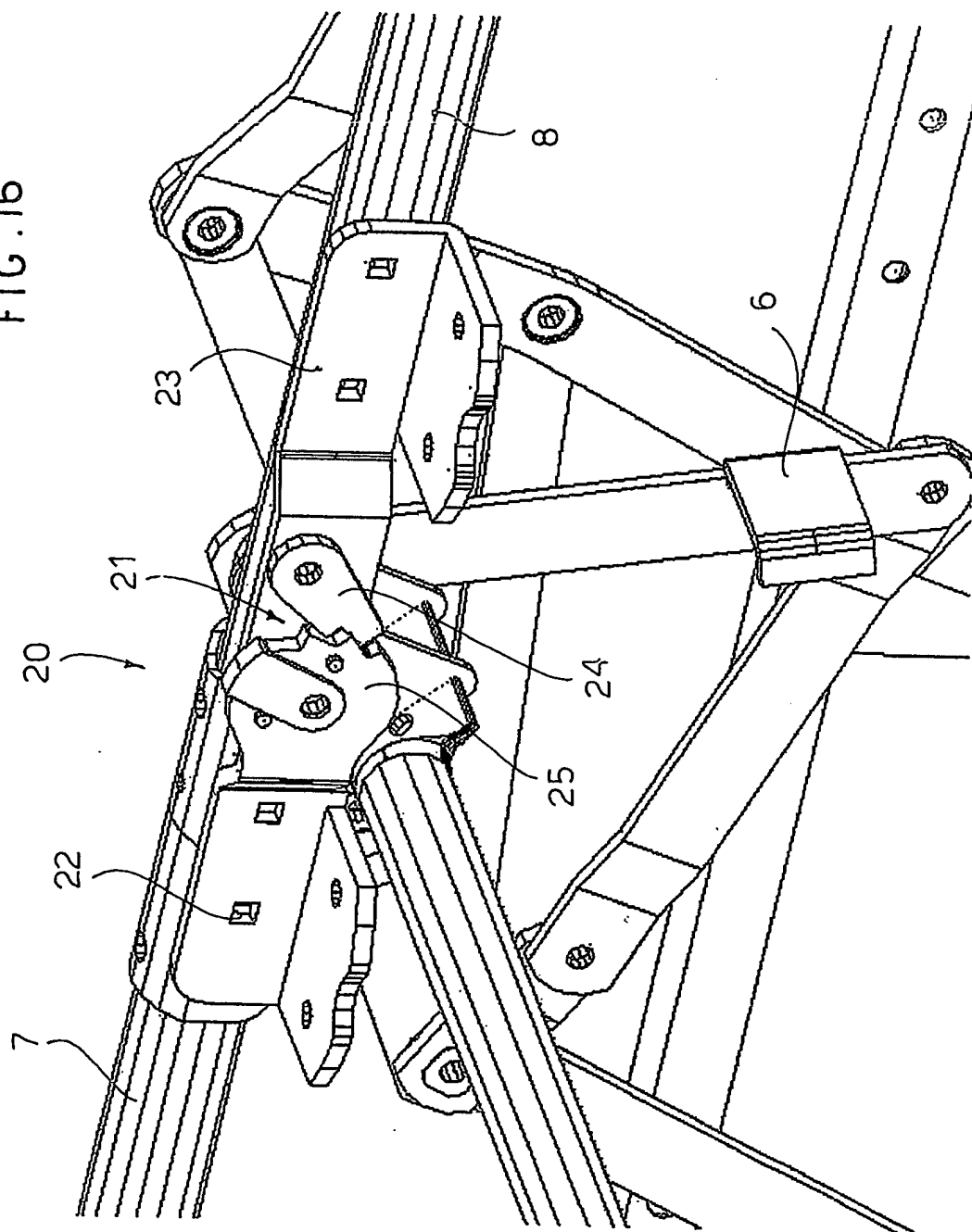


FIG. 16



INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP2004/000341

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A47C17/22 A47C17/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A47C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 104 747 A (BELL RICHARD A ET AL) 8 August 1978 (1978-08-08) column 3, line 1 - column 4, line 21; figures 1-5	1-4
X	US 3 284 814 A (MIKOS ALOYSIUS J) 15 November 1966 (1966-11-15) figures 1-10 column 3, line 51 - column 5, line 34 column 6, line 7 - line 16	1-3,6
X	US 3 516 096 A (MIKOS ALOYSIUS J) 23 June 1970 (1970-06-23) figures 1-25 column 7, line 21 - line 39 the whole document	1-3,6
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search

10 May 2004

Date of mailing of the international search report

27 AUG. 2004

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/000341

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 597 115 A (POKORNY JR LOUIS ET AL) 1 July 1986 (1986-07-01) the whole document -----	1-3,6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2004/000341

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-7

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7

A mechanism for opening/closing a sofa bed.

2. claims: 8-14

A mechanism for adjusting a sofa bed to an intermediate (relax) position.

INTERNATIONAL SEARCH REPORT

■ information on patent family members

International Application No

PCT/EP2004/000341

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4104747	A	08-08-1978	NONE	
US 3284814	A	15-11-1966	NONE	
US 3516096	A	23-06-1970	NONE	
US 4597115	A	01-07-1986	NONE	

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